Atlantic Richfield Company

Treatment System Operation and Maintenance

Technical Advisory Committee Meeting

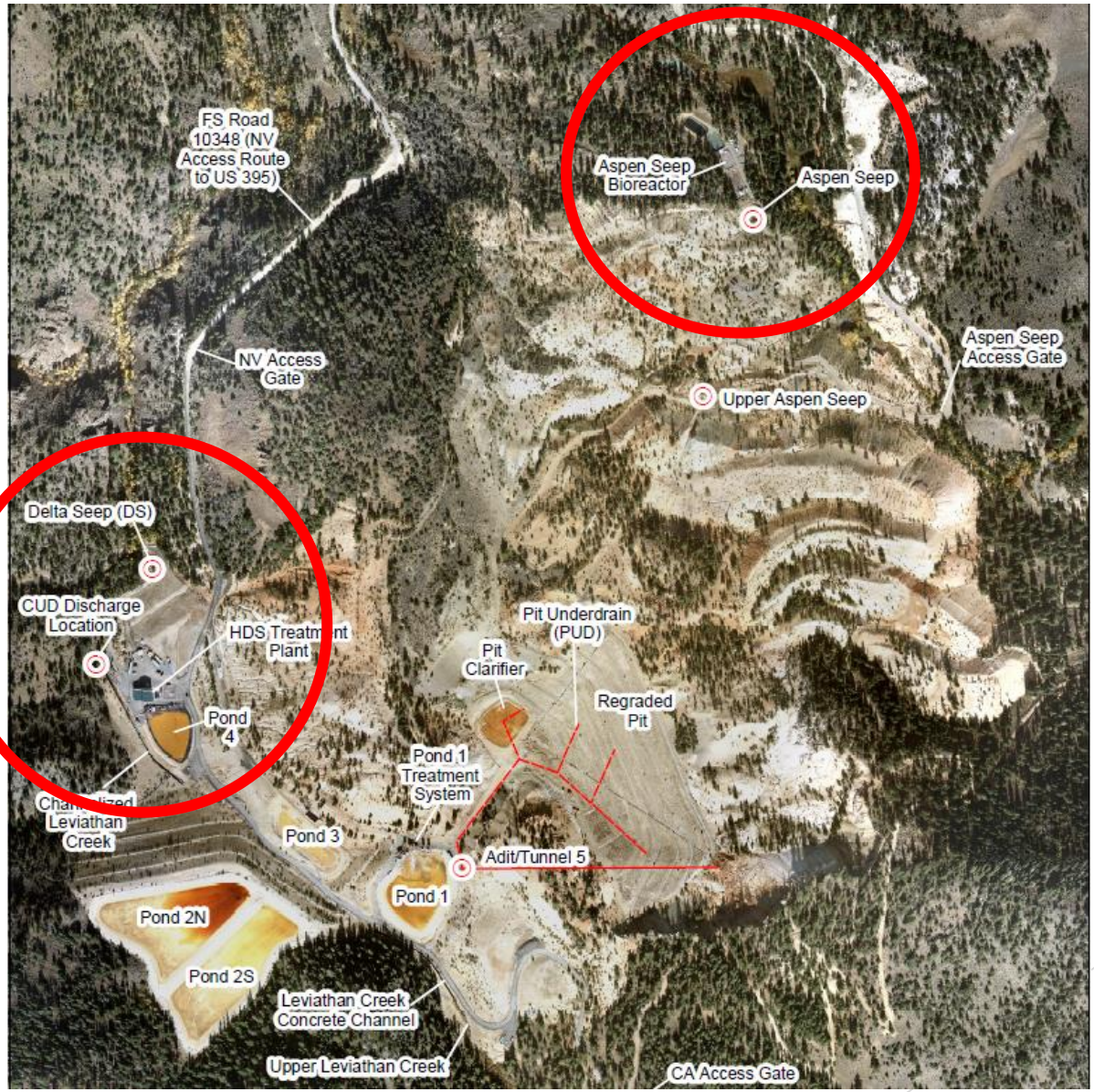
Leviathan Mine Site

January 20, 2015

Outline

- Current Treatment System History
- Spring Access and Operations Setup
- High Density Sludge (HDS) Treatment System
- Aspen Seep Bioreactor (ASB) Treatment System

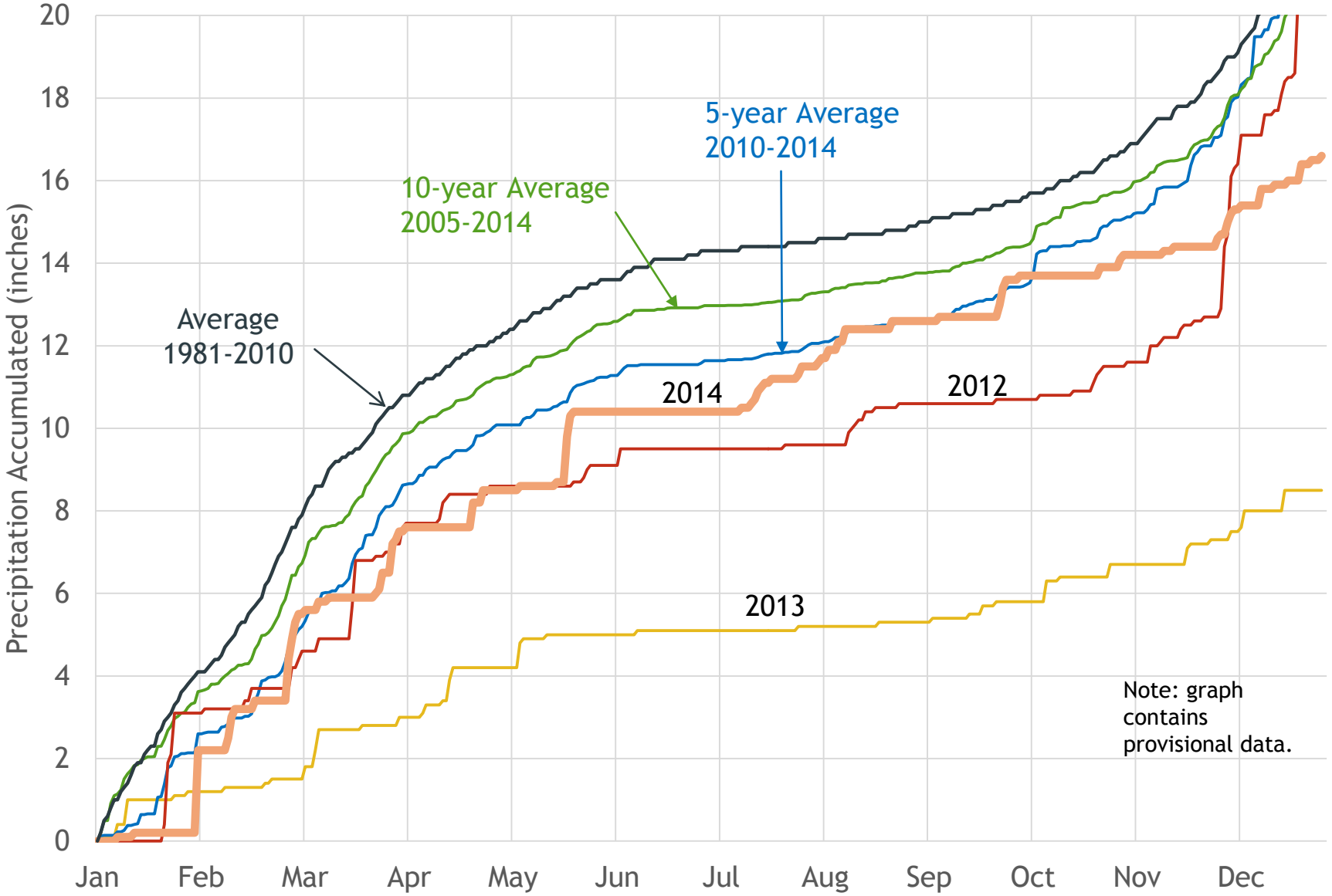
Leviathan Mine Site



Current Treatment System History

- HDS
  - 2005–2006 - HDS pilot system
  - 2007–2009 – Pond 4 Lime Treatment System (LTS)
  - 2009–Present - HDS Treatment Plant
- ASB
  - 2000-2002 - Designed by scientists from UNR with input from U.S. EPA and Atlantic Richfield
  - 2002-2003 - Construction of Bioreactor
  - 2004 – Recirculation added
  - 2007-2008 – Updates to Chemical Feed and Power Generation System

SNOTEL - Monitor Pass



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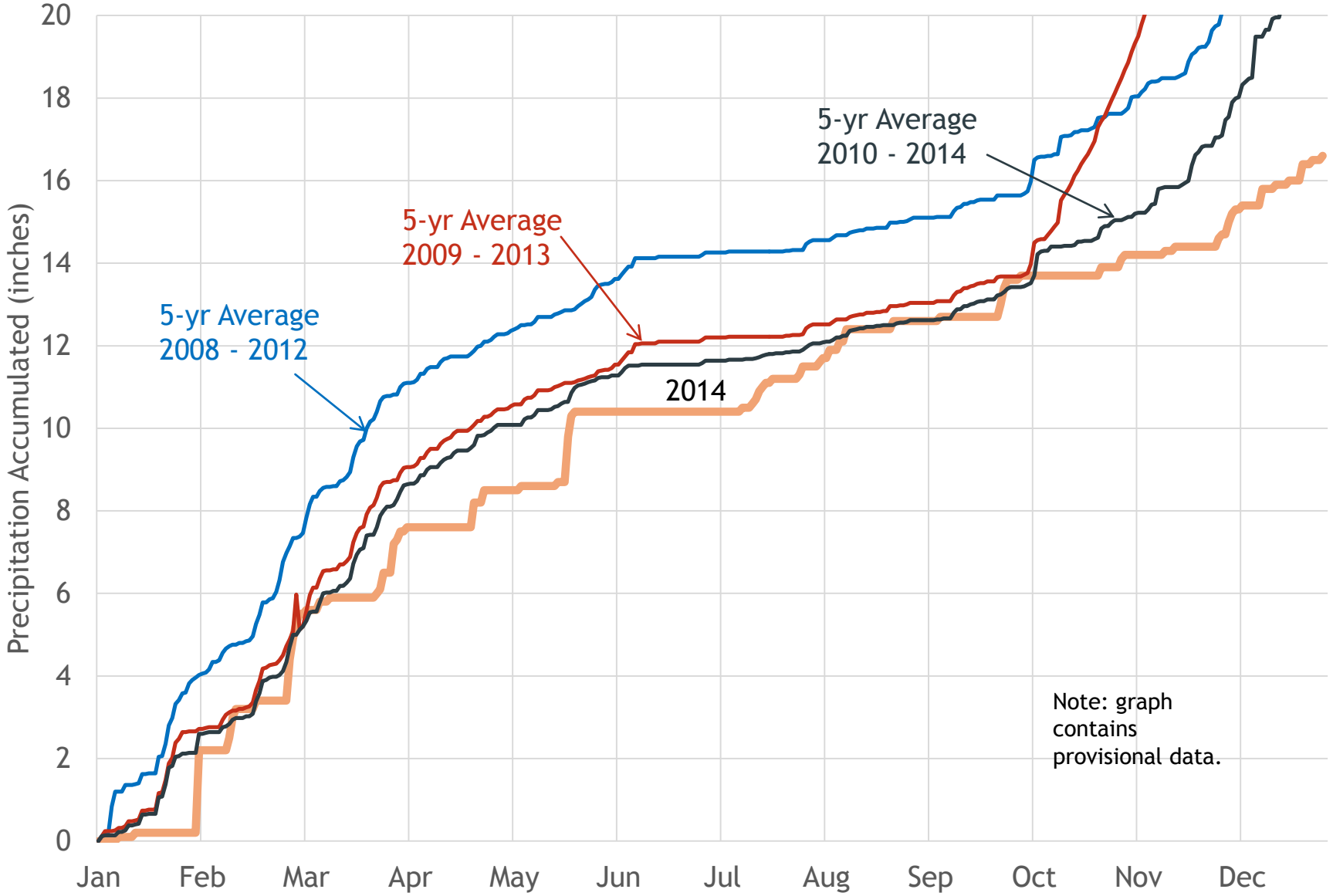


Spring Access and Operations Setup

Provide safe access as soon as possible

- April 17, 2014
  - Accessed site, evaluated road conditions, and began Nevada Access Road maintenance
- April 18, 2014
  - Initiated site setup activities in the Pond 4 area including spring commissioning of the HDS Treatment System
- May 8, 2014
  - Began capture at Channel Underdrain (CUD) and Delta Seep (DS)

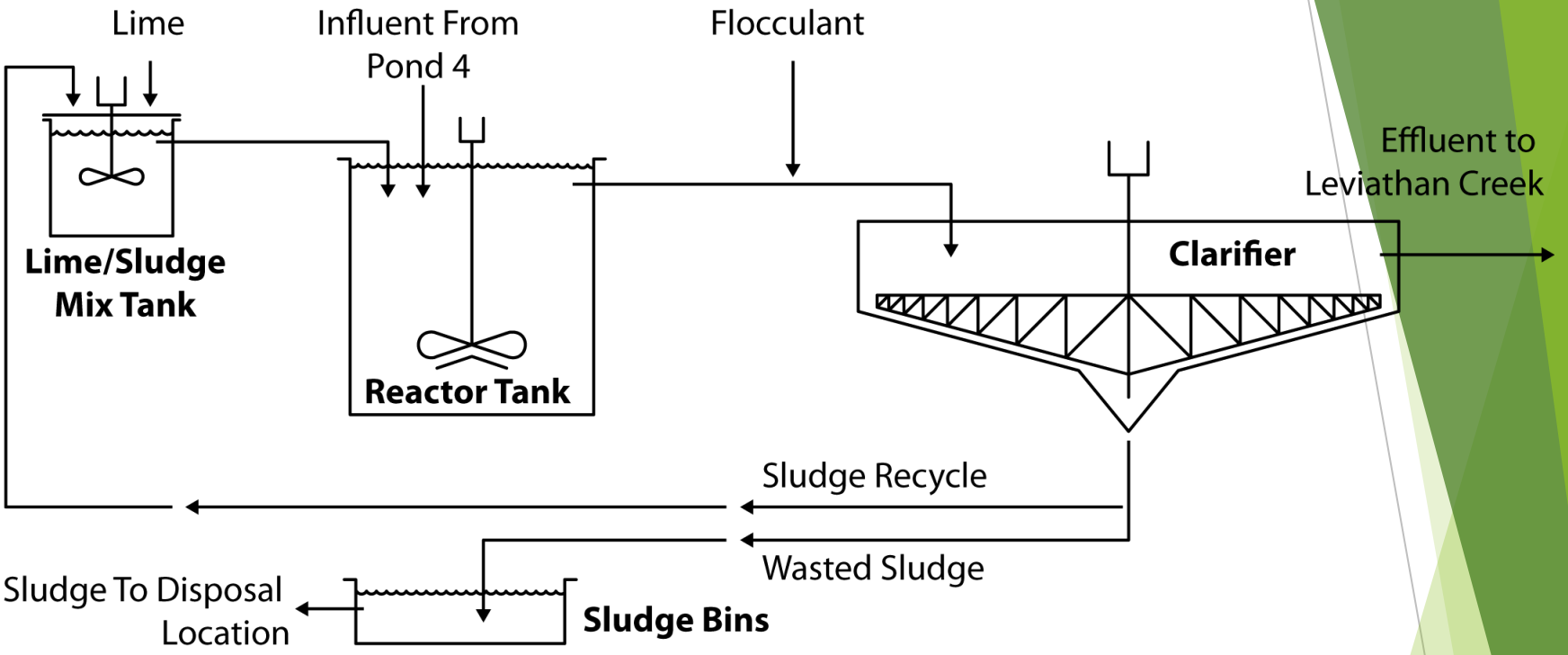
HDS Treatment System

HDS Treatment System – Background

HDS System Components

- Capture and Conveyance
  - 2 capture locations
    - Channel Underdrain (CUD)
    - Delta Seep (DS)
  - Pond 4 (Pre-treatment Water Storage)
  - Influent Pumps

HDS Treatment System – Background



HDS Basics

- Increase pH with lime and precipitate metals as hydroxides
- HDS Advantages
  - low sludge volumes
  - better lime efficiency
  - Increased settling

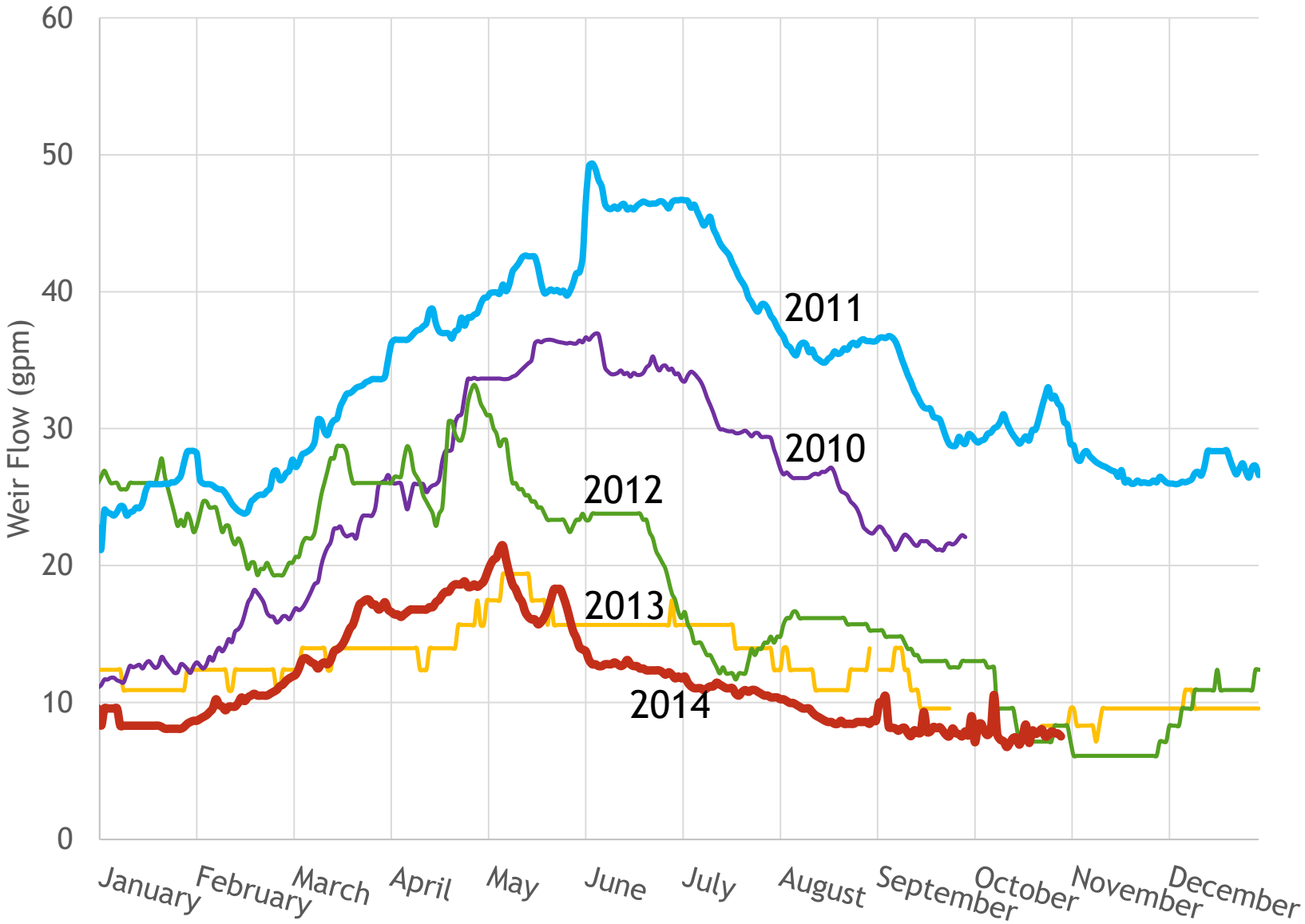
HDS Treatment System – Highlights

- Captured and treated CUD and DS from late May through late October
- Successfully treated approximately 3.78 million gallons of acid drainage
- All discharge to Leviathan Creek met discharge criteria

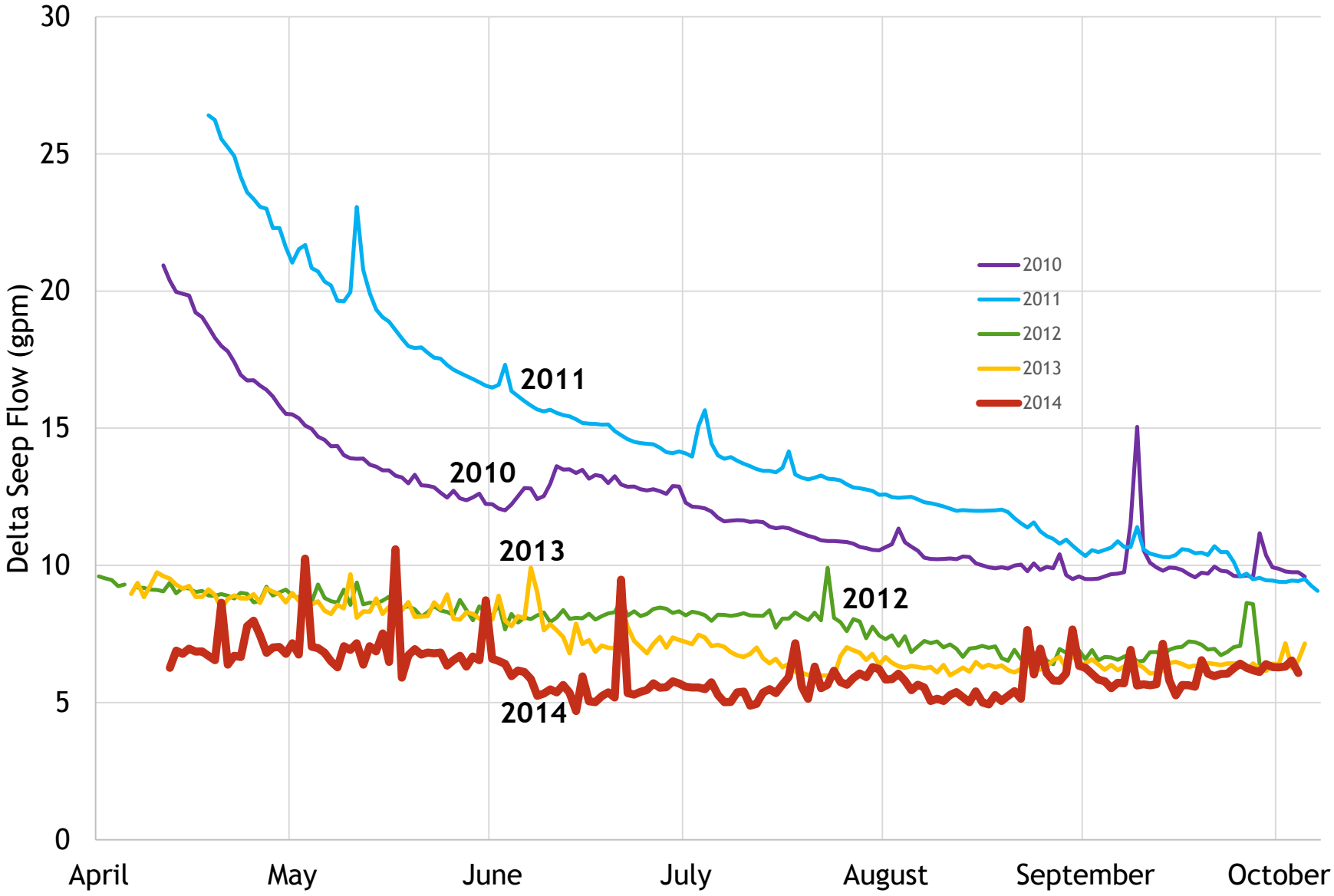
HDS Treatment System – Operations

- May 27, 2014
  - Began treatment plant operations
- May 30, 2014
  - Began discharge to Leviathan Creek
- October 13, 2014
  - Began HDS Treatment Plant Capacity Testing
- October 17, 2014
  - HDS Treatment Plant Capacity Testing ended
- October 30, 2014
  - Capture of CUD and DS flows ended
- October 30, 2014
  - HDS Treatment Plant Discharge to Leviathan Creek ended
  - Pumped Pond 4 down to approximately 15 inches of water remaining

Channel Underdrain Historic Flow



Delta Seep Historic Flow



HDS Treatment System Optimization

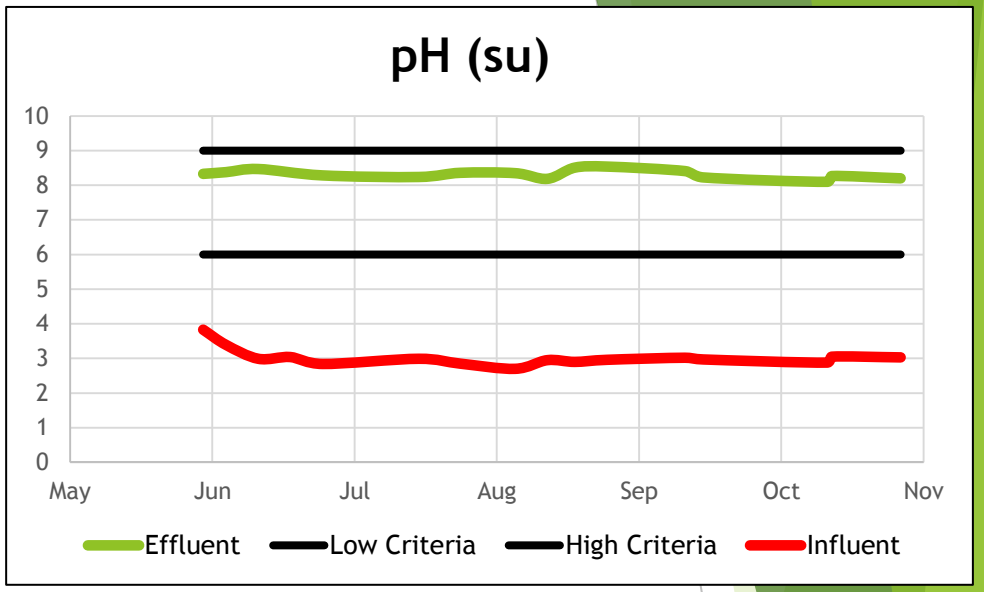
Continued system optimization to ensure safe and reliable operations

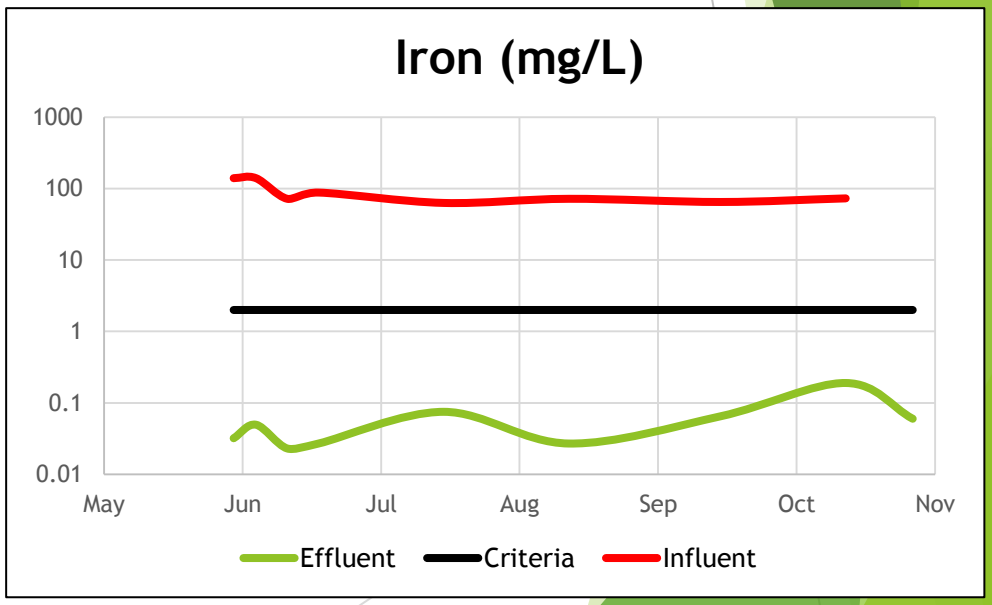
- Replaced lime sludge mix tank and reactor agitator blades
- Treatment system data storage upgrade
- Fire control panel & detectors
- Ran the plant in intermittent mode but for longer periods of time
- Storm water BMP improvements and maintenance
- Began engineering for battery backup low battery alarm
- Flocculant access stairs and drain lines
- GFEP for heat trace power

HDS Effluent

Analyte	Max	Criteria
Aluminum	0.410	4
Arsenic	0.0013	0.34
Cadmium	<0.001	0.009
Chromium	<0.002	0.97
Copper	0.0068	0.026
Iron	0.190	2
Lead	<0.0025	0.136
Nickel	0.053	0.84
Zinc	0.013	0.21

Note: Criteria is Discharge Daily Grab. All analytes are dissolved and in mg/L except pH, which is su





HDS Treatment System – Winterization

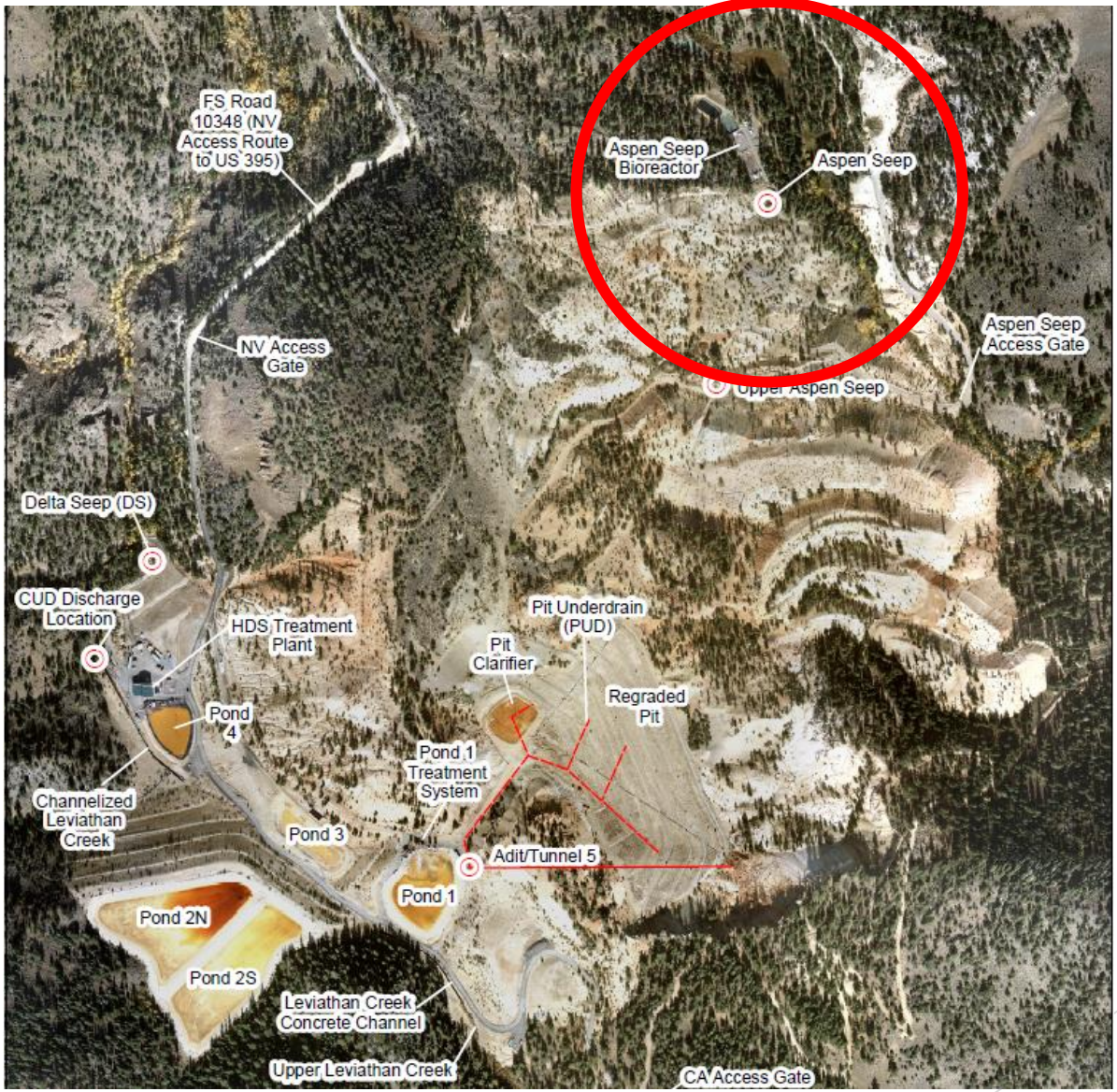
- Winterization of the HDS Treatment Plant and operation support area occurred from October 31, 2014 through November 13, 2014
- November 12, 2014 site office trailers were removed
- Consumables stored on-site to facilitate spring commissioning (Need to get from BAI)
  - 4,400 gal diesel
  - 7.2 tons lime (12 bags)
  - 45.4 kg flocculant

HDS Treatment System – Consumables Information

	Lime Utilization	Polymer Utilization	Sludge Generation		Energy Usage	Fuel Consumption
2014 Unit Rate	0.36 g/L	1.40 mg/L	3.0 ton/MG	3.4 CY/MG	LAS = 4,272 ARWS = 4,613 kWh/week	LAS = 51 ARWS = 53 Gal/Day
2014 Total	5.7 tons	20 kg	11.21 tons	13 CY	123,142 kWh	10,801 gallons

	Lime Utilization	Polymer Utilization	Sludge Generation		Energy Usage	Fuel Consumption
2011 Unit Rate	0.78 g/L	6.43 mg/L	8.7 ton/MG	6.5 CY/MG	LAS = 6,500 ARWS = 5,500 kWh/week	LAS = 69 ARWS = 73 Gal/Day
2011 Total	42.5 tons	319 kg	153 tons	114 CY	155,850 kWh	15,346 gallons

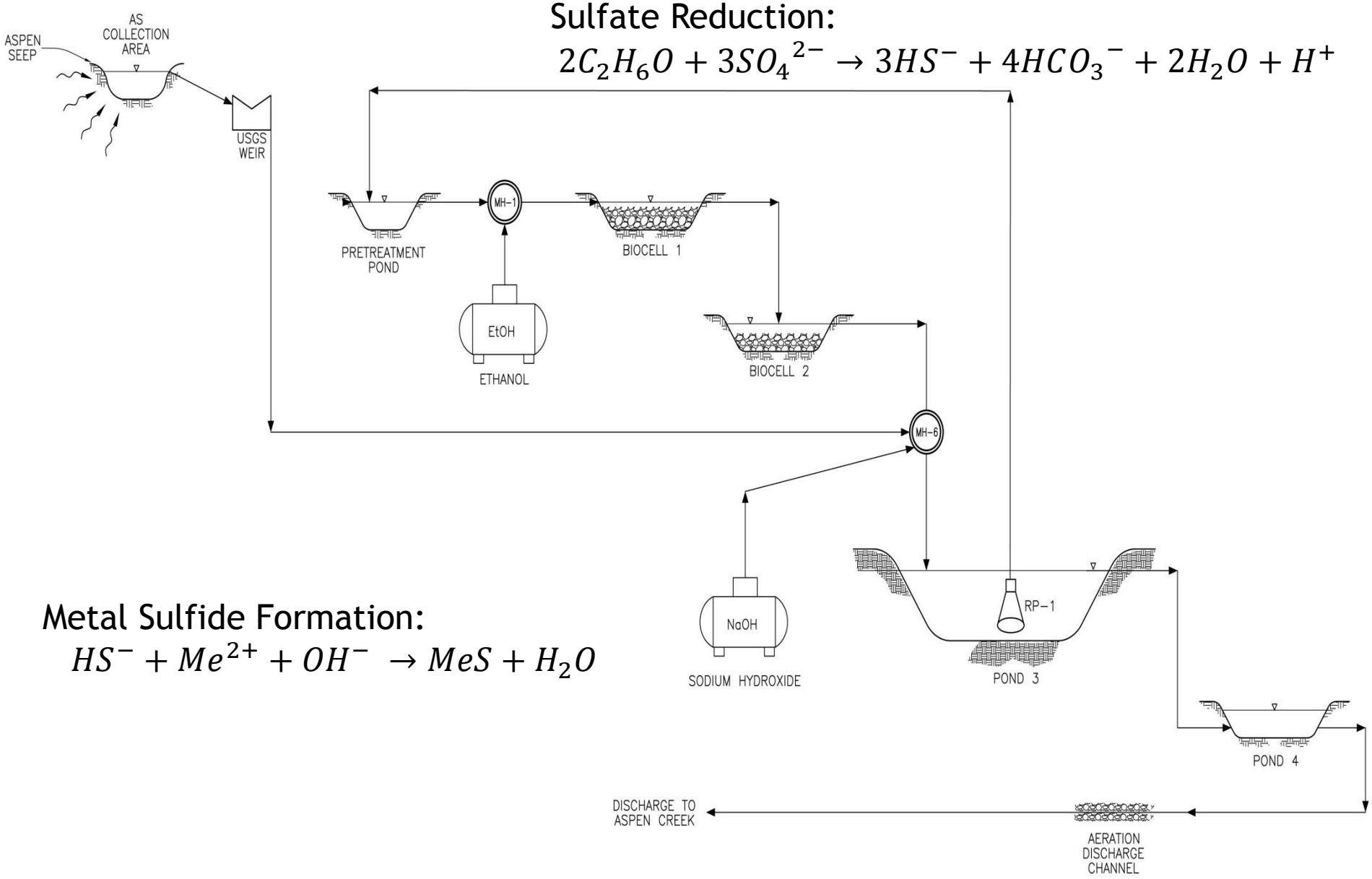
ASB Treatment System



ASB Treatment System – Background

Sulfate Reduction:

$$2C_2H_6O + 3SO_4^{2-} \rightarrow 3HS^- + 4HCO_3^- + 2H_2O + H^+$$



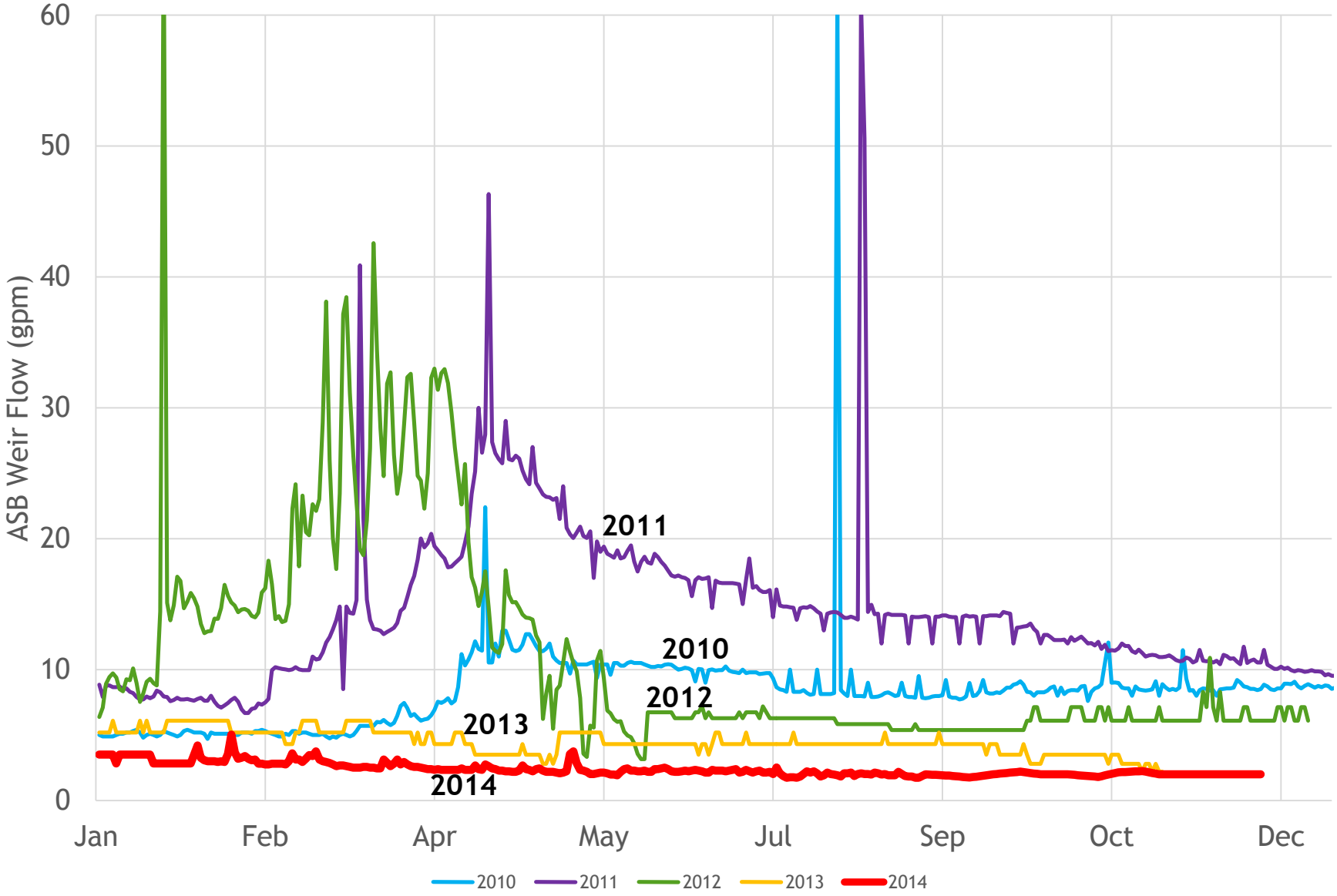
Metal Sulfide Formation:

$$HS^- + Me^{2+} + OH^- \rightarrow MeS + H_2O$$

ASB Treatment System – Operations

- LAS Operations
  - Monthly visits for system O&M, cold weather system upsets, and compliance sampling
  - Specialized training for Winter Access
  - Detailed planning, preparation, and coordination
  - Team used 4x4 vehicles to access the site during winter visits in 2014
- ARWS Operations
  - Performed system O&M and improvements
  - Monthly compliance sampling
  - Solids management - Transferred solids from Pond 3 to Pond 4

ASB Influent Historic Flow Rates



ASB Treatment System Maintenance Activities

- Biocell flushing
- Completion of maintenance on storm water BMPs in the Pond 4 and Aspen Seep areas
- Transfer of sludge from Pond 3 to Pond 4
  - No solids dewatering or off-site disposal in 2014
- Replacement of the ASB Human Machine Interface (HMI) computer
- Abandonment of the Bypass Line
- Fire Control Panel Upgrade
- Fuel Solenoid UPS backup
- Recirculation pump platform
- Generator Load Bank Testing

ASB Effluent

Analyte	Max	Criteria
Aluminum	0.230	4
Arsenic	0.005	0.34
Cadmium	<0.00025	0.009
Chromium	<0.0005	0.97
Copper	0.0021	0.026
Iron	0.082	2
Lead	<0.0005	0.136
Nickel	0.024	0.84
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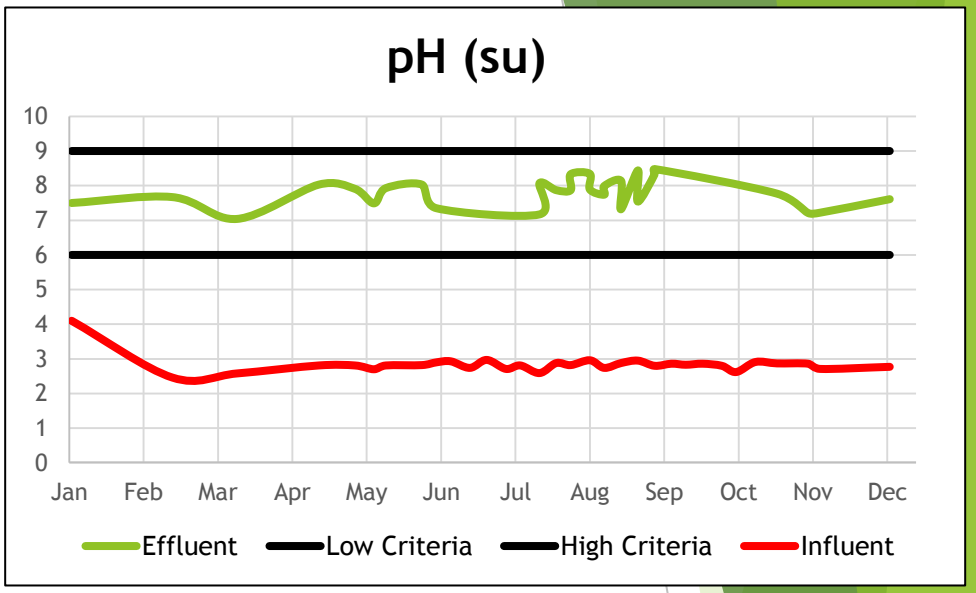

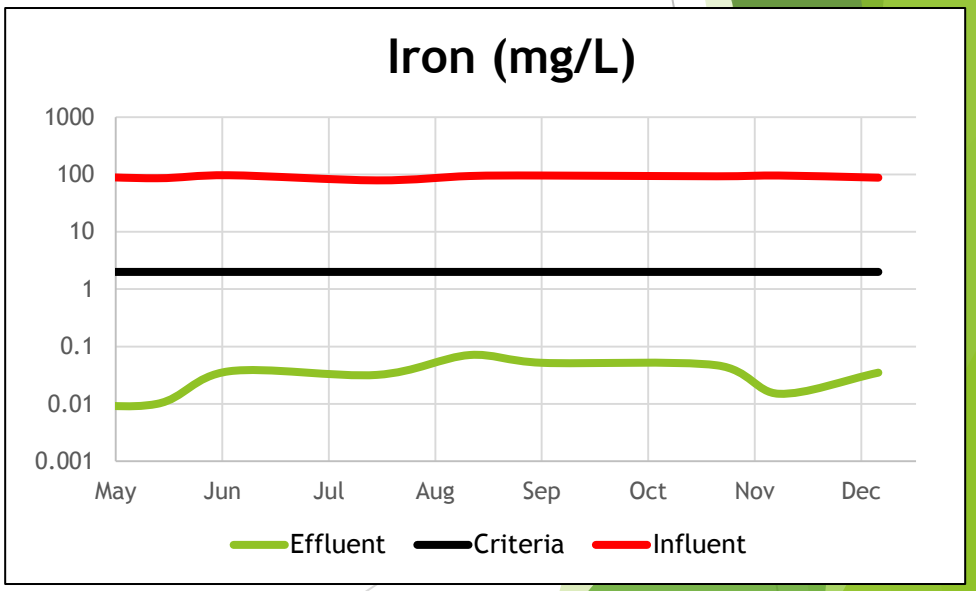

ASB Treatment System – Performance

- Site improvements continue to increase system control and monitoring
- Indicator parameters demonstrate good bioreactor performance
  - Average effluent pH of 7.8
  - Average biocell ORP of -328 mV
  - Consistently high sulfate removal (400–1100 mg/L)
- Consistently met discharge criteria with no exceedances

ASB Treatment System – Consumables Information

	NaOH Utilization	Ethanol Utilization	Energy Usage	Propane Fuel Consumption
2014 Unit Rate	1.40 ml/L	0.72 ml/L	ARWS = 210 LAS = 250 kWh/Week	ARWS = 10 LAS = 15 Gal/Day
2014 Totals	1,733 Gal	890 Gal	12,330 kWh	4,903 Gallons

	NaOH Utilization	Ethanol Utilization	Energy Usage	Propane Fuel Consumption
2011 Unit Rate	1.15 ml/L	0.39 ml/L	ARWS = 230 LAS = 245 kWh/Week	ARWS = 11 LAS = 11 Gal/Day
2011 Totals	9,117 Gal	3075.2 Gal	12,500 kWh	4,000 Gallons

Questions